Inpatient Hyperglycemia - Adult

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Note: Insulin dose adjustments should be made based on the individual patient’s glucoses. Refer to the Hypoglycemia Management algorithm, as indicated.

**PRESENTATION**

- Patient with known diabetes or blood glucose > 180 mg/dL

**INITIAL EVALUATION**

- Check hemoglobin A1c if not completed within the last 3 months
- Begin POC glucose monitoring

- Does patient meet diagnostic criteria for hyperglycemic emergency?
  - Yes
    - See Hyperglycemic Emergency Management (DKA/HHS) – Adult algorithm
  - No
    - Type 1 diabetes or insulin pump or history of total pancreatectomy
    - Page Endocrinology-Diabetes for urgent consultation which requires clinician to clinician communication
    - Type 2 diabetes or steroid induced diabetes/ hyperglycemia
    - See Page 2
    - No history of diabetes
    - See Page 4

DKA = diabetic ketoacidosis
HHS = hyperosmolar hyperglycemic state
POC = point of care

1 Hemoglobin A1c may be inaccurate if recent blood transfusion within the past three months or severe anemia
2 Diagnostic criteria:
  - DKA: blood glucose > 250 mg/dL and arterial pH < 7.3 or bicarbonate < 15 mEq/L, and moderate ketonuria or ketonemia
  - [Note: Blood glucose may be lower than expected in patients on SGLT-2 inhibitors (e.g., empagliflozin, canagliflozin, etagliiflozin and dapagliflozin)]
  - HHS: blood glucose > 600 mg/dL and arterial pH > 7.3 or bicarbonate > 15 mEq/L, and minimal ketonuria and ketonemia
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Note: Insulin dose adjustments should be made based on the individual patient’s glucoses. Refer to the Hypoglycemia Management algorithm, as indicated.

**PRESENTATION**
Type 2 diabetes or steroid induced diabetes/hyperglycemia

- Stop high-risk home medications\(^1\)
- Hold metformin if eGFR < 45 mL/minute/1.73 m\(^2\)

**ASSESSMENT**

Is patient on > 100 units of insulin daily\(^2\) or on Humulin U-500 insulin at home?

- Yes
  - Consult Endocrinology-Diabetes
  - See Page 3
- No
  - Does patient have risk factors for hyperglycemia or hypoglycemia\(^3\)?
    - Yes
      - Initiate basal bolus insulin therapy at 0.4 units/kg/day subcutaneous with 50% of TDD used for prandial fixed bolus (lispro) dosing and 50% used for basal (glargine) dosing (see Appendix A and B)
      - Assess insulin needs every 24 hours
      - Consider a no concentrated carbohydrate diet
      - No
      - See Page 3

**TREATMENT**

Are any glucose levels > 180 mg/dL after 48 hours?

- Yes
  - Consult General Internal Medicine (Consultative Medicine - Inpatient Consults) or Endocrinology-Diabetes
  - Discharge planning:
    - Consider resuming home medications, as appropriate
    - Consider the following as clinically indicated:
      - For patients with hemoglobin A1c < 7.5%:
        - Follow up with treating physician, primary care physician, or endocrinologist
      - For patients with hemoglobin A1c 7.5-9%:
        - Consult Diabetes Educator
        - Follow up with treating physician, primary care physician, or endocrinologist or arrange ambulatory referral to Consultative Medicine (General Internal Medicine)
      - For patients with hemoglobin A1c > 9% or new to insulin on discharge:
        - Consult Diabetes Educator
        - Arrange ambulatory referral to Endocrinology-Diabetes

- No
  - Refer to Insulin Decision Support Tool to assist in placing orders for internal use only

Note: Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

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\(^1\) Hold home insulin and oral hypoglycemic agents such as sulfonylureas (glibizide, glyburide, glimepiride, gliclazide), meglitinides (repaglinide, nateglinide) and SGLT-2 inhibitors (canagliflozin, dapagliflozin, empagliflozin, ertugliflozin). Generally, metformin and DPP-4 inhibitors (sitagliptin, linagliptin, saxagliptin) are safe to continue if renal and liver function are stable.

\(^2\) Calculation of total daily insulin taken at home: add the total units of all long acting (glargine, degludec, or detemir), intermediate acting (NPH), and short acting (lispro, aspart, glulisine, or regular) insulin in a typical 24 hour period.

\(^3\) Risk factors for hyperglycemia include: New enteral feedings or TPN • Post-operative status • High dose steroids (see Page 3)

Risk factors for hypoglycemia include: Acute or chronic renal failure • Poor nutritional status or oral intake • Failure to thrive • NPO status for anticipated procedures

\(\text{eGFR} = \text{estimated glomerular filtration rate}\)
\(\text{NPH} = \text{neutral protamine Hagedorn}\)
\(\text{NPO} = \text{nothing by mouth}\)
\(\text{TDD} = \text{total daily dose}\)
\(\text{TPN} = \text{total parenteral nutrition}\)
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Note: Insulin dose adjustments should be made based on the individual patient’s glucose levels. Refer to the Hypoglycemia Management algorithm, as indicated.

**ASSESSMENT**

- New enteral feedings or TPN: Consult Endocrinology-Diabetes
- High risk for hypoglycemia: acute or chronic renal failure or failure to thrive:
  - Initiate basal insulin (glargine) at 0.15 units/kg/day subcutaneous and supplemental sliding scale bolus insulin (lispro) subcutaneous (see Appendix A and B)
  - Assess insulin needs every 24 hours
- High risk for hypoglycemia: poor nutritional status or oral intake, or NPO status for anticipated procedures:
  - Initiate basal insulin (glargine) at 0.2 units/kg/day subcutaneous and supplemental sliding scale bolus insulin (lispro) subcutaneous (see Appendix A and B)
  - Assess insulin needs every 24 hours
- Post-operative status:
  - Initiate Post-Operative Insulin Basal Bolus order set (see Appendix B)
  - Assess insulin needs every 24 hours
  - If steroid use is anticipated on discharge, consider Endocrinology-Diabetes consult
- High dose steroids:
  - Initiate basal bolus insulin therapy at 0.6 units/kg/day subcutaneous with 60% of TDD used for prandial fixed bolus (lispro) dosing and 40% used for basal (glargine) dosing (see Appendix A and B)
  - Assess insulin needs and steroid dosing every 24 hours
  - If steroid use is anticipated on discharge, consider Endocrinology-Diabetes consult
  - Consider a no concentrated carbohydrate diet

**TREATMENT**

- Consult Endocrinology-Diabetes
- Are any glucose levels > 180 mg/dL after 48 hours?
  - Yes
  - Discharge planning:
    - Consider resuming home medications, as appropriate
    - Consider the following as clinically indicated:
      - For patients with hemoglobin A1c < 7.5%:
        - Follow up with treating physician, primary care physician, or endocrinologist
      - For patients with hemoglobin A1c 7.5-9%:
        - Consult Diabetes Educator
        - Follow up with treating physician, primary care physician, or endocrinologist or arrange ambulatory referral to Consultative Medicine (General Internal Medicine)
      - For patients with hemoglobin A1c > 9% or new to insulin on discharge:
        - Consult Diabetes Educator
        - Arrange ambulatory referral to Endocrinology-Diabetes
  - No

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Note: Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

1 High dose steroid therapy is considered to be ≥ 8 mg of dexamethasone, 50 mg of prednisone, 40 mg of methylprednisolone or 200 mg of hydrocortisone per day
2 If this is a recurrent admission for chemotherapy containing steroids, please check last Endocrinology-Diabetes note for more specific insulin dose recommendations and use if appropriate
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Note: Insulin dose adjustments should be made based on the individual patient’s gluoses. Refer to the Hypoglycemia Management algorithm, as indicated.

**PRESENTATION**

- **No history of diabetes**
  - **Is patient on high dose steroid therapy\(^1\)?**
    - **Yes**
      - **Initiate basal bolus insulin therapy at 0.5 units/kg/day subcutaneous with 60% of TDD used for prandial fixed bolus (lispro) dosing and 40% used for basal (glargine) dosing (see Appendix A and B)**
      - **Assess insulin needs and steroid dosing every 24 hours**
      - **Consider a no concentrated carbohydrate diet**
    - **No**
      - **Consult Diabetes Educator**
      - **Consult Endocrinology-Diabetes**

- **Consult Diabetes Educator**
  - **Consult Endocrinology-Diabetes**

**ASSESSMENT**

- **Are any glucose levels > 180 mg/dL after 48 hours?**
  - **Yes**
    - **Consider initiation of basal bolus insulin therapy at 0.3 units/kg/day subcutaneous with 50% of TDD used for prandial fixed bolus (lispro) dosing and 50% used for basal (glargine) dosing (see Appendix A and B)**
    - **Assess insulin needs every 24 hours**
  - **No**
    - **Consult Diabetes Educator**
    - **Consult Endocrinology-Diabetes**

**TREATMENT**

- **Are there 2 consecutive glucose levels > 180 mg/dL within 24 hours?**
  - **Yes**
    - **Consult Diabetes Educator**
    - **Consult Endocrinology-Diabetes**
  - **No**

**Discharge planning:**
- **Consider the following as clinically indicated:**
  - For patients with hemoglobin A1c < 7.5%:
    - Follow up with treating physician, primary care physician, or endocrinologist
  - For patients with hemoglobin A1c 7.5-9%:
    - Consult Diabetes Educator
    - Follow up with treating physician, primary care physician, or endocrinologist or arrange ambulatory referral to Consultative Medicine (General Internal Medicine)
  - For patients with hemoglobin A1c > 9% or new to insulin on discharge:
    - Consult Diabetes Educator
    - Arrange ambulatory referral to Endocrinology-Diabetes

Note: Refer to Insulin Decision Support Tool to assist in placing orders (for internal use only)

\(^1\) High dose steroid therapy is considered to be ≥ 8 mg of dexamethasone, 50 mg of prednisone, 40 mg of methylprednisolone or 200 mg of hydrocortisone per day

\(^2\) Checkpoint inhibitors: nivolumab, pembrolizumab, durvalumab, atezolizumab, and related drugs. Patients with recent exposure to checkpoint inhibitors are at risk for DKA and should be evaluated for possible new onset type 1 diabetes mellitus.
### APPENDIX A: Common Insulin Types and Frequency

<table>
<thead>
<tr>
<th>Fast Acting Insulin</th>
<th>Dose Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lispro (Humalog® or Lyumjev®)</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Aspart (Novolog® or Fiasp®)</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Glulisine (Apidra®)</td>
<td>Before meals or every 4 hours</td>
</tr>
<tr>
<td>Regular insulin (Novolin®-R/Humulin®-R)</td>
<td>Before meals or every 6 hours</td>
</tr>
</tbody>
</table>

**Long Acting Insulin**

| Glargine (Lantus®/Basaglar®/Toujeo®) | Daily or every 12 hours |
| Detemir (Levemir®)                  | Daily or every 12 hours  |
| Degludec (Tresiba®)                 | Daily                    |

**Intermediate Acting Insulin**

| NPH (Novolin®-N/Humulin®-N)        | Every 12 hours            |

**Mixed Insulin**

| 70/30, 75/25¹, 50/50¹ (mixes of NPH and a fast acting insulin) | Every 12 hours or every 6 hours with continuous tube feedings |

¹ Not currently on MD Anderson Formulary

### APPENDIX B: Basal Bolus Insulin Terms

- **Bolus** insulin refers to a dose of fast acting insulin. This is typically comprised of **prandial** insulin which is scheduled to compensate for the carbohydrate content of a meal and **supplemental** (or sliding scale) insulin to correct hyperglycemia. Bolus insulin is most effective when given before meals, but supplemental insulin alone can be scheduled for patients who are not eating or are high risk for hypoglycemia.

- **Basal** insulin refers to a dose of long acting insulin given 1 or 2 times daily. These insulins absorb slowly to help maintain stable glucose levels.

- **Supplemental** insulin is dosed based on either weight or total daily insulin requirement.

- A **basal/bolus** insulin regimen uses both types of insulin to recreate a physiologic pattern of insulin release. This regimen is more effective for most patients than sliding scale supplemental insulin only. Most patients need about half of their insulin as basal and half as bolus. Patients on high doses of steroids will often need more bolus insulin.
SUGGESTED READINGS


DEVELOPMENT CREDITS

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